**Dry Lab: Comparing Mitosis and Meiosis**

**Learning goals:**

-to identify cells in the different stages of mitosis

-to experimentally determine in which stage the cell spends most of its time

-to describe the different stages of mitosis

-to compare cytokinesis in plant and animal cells

-to view and describe the stages of meiosis

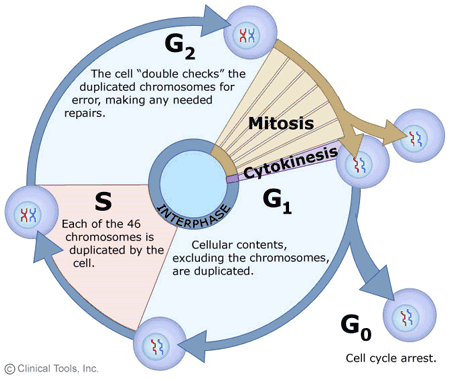
-to describe how crossing over contributes to genetic variability

-to compare and contrasts mitosis and meiosis processes

-to learn vocabulary associated with these processes (*meiosis, mitosis, cytokinesis, somatic cells, germ cells, chromosome, centrioles, centromere, spindle fibers, chiasmata, homologous chromosomes, crossing over, gene)*.

**Introduction:**

In 1858, Rudolf Virchow discovered that new cells can only arise from previously existing cells. There are two processes that give rise to new cells: mitosis and meiosis. Somatic (body) cells divide exclusively by mitosis (division of nuclear material) followed by splitting of the cytoplasm and organelles, called cytokinesis. Meiosis is the process through which specialized germ cells produce gametes (sex cells).

**PART I. MITOSIS**

Before mitosis occurs, the cell must duplicate all of its genetic material. This occurs during interphase (*refer to the Cell Cycle diagram on the right*).

Mitosis is a continuous process, but can be divided into four major phases: prophase, metaphase, anaphase, telophase.

1. **Stages of Mitosis**

Briefly describe what happens in each stage, using the space and diagrams on the next page (*please, use your textbook for help*).

|  |  |
| --- | --- |
| **Mitosis.jpgProphase** |  |
| **Mitosis.jpgMetaphase** |  |
| **Mitosis.jpgAnaphase** |  |
| **Mitosis.jpgTelophase** |  |

*Note: The diagrams above represent phases of animal meiosis.*

**2. Observing Mitosis in Plant Cells under the Microscope**

Materials:

-microscope

-prepared microscope slide of onion root tip mitosis

Procedure:

1. Turn on the microscope. Make sure it is set to the lowest power.
2. Place the microscope slide on the stage.
3. Observe the onion root tip, first at 100X, then at 400X.
4. Identify the cells which represent each mitotic phase. Draw each phase of plant cell mitosis that you see below (*please, label each phase)*.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

1. Examine at least 3 *different* fields of view at 400X magnification. (*Make sure that none of the fields of view overlap!).* For each field of view, **count** the number of cells in interphase and each phase of mitosis. Record your observations in the table below.
2. Calculate the **total** number of cells counted. Then, calculate the **percent** of total number of cells for interphase and each phase of mitosis. Record in the table on page 4.

Total # of Cells (for all 3 fields of view): \_\_\_\_\_\_\_\_

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | # of cells in Field 1 | # of cells in Field 2 | # of cells in Field 3 | % of Total # of Cells |
| Interphase |  |  |  |  |
| Prophase |  |  |  |  |
| Metaphase |  |  |  |  |
| Anaphase |  |  |  |  |
| Telophase |  |  |  |  |

Analysis Questions

1. a) Using the information in the table above, determine which phase takes the *longest* for the cell to complete. Explain.

b) Sketch a pie graph of the percentage of cells in each phase to support your answer in part a).

1. What is the relationship between the process of mitosis and cytokinesis?
2. What are the primary differences between cell division in plants and mitosis in animals? (Name at least 2 differences).

**PART II. MEIOSIS**

Meiosis is a process of nuclear division that occurs only in specialized *germ cells*. The end products of meiosis are sex cells, called *gametes* (eggs and sperm in animals). Gametes have **half** the number of chromosomes (*haploid)* compared to a somatic cell (*diploid*). The daughter cells of meiosis are also genetically different from parent cells due to crossing over and random assortment that occur in meiosis I.

Meiosis consists of two divisions, Meiosis I and Meiosis II, which are further subdivided into four phases (prophase, metaphase, anaphase and telophase). Meiosis can produce up to four daughter cells.

One of the sex organs in a lily flower is the anther. Each anther has two pairs of microsporangia (“pollen sacs”), which produce pollen, containing sperm cells. The process of meiosis can be observed in cells of microsporangia.

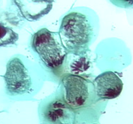
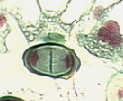
*anther*

*microsporangia*

Process:

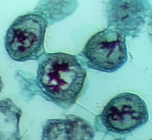
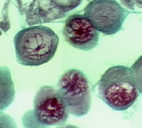
The cross-section of a lily anther (*see below*) is in the early stages of meiosis.

1. Identify the stages of Meiosis I the cells are in (prophase I, metaphase I, anaphase I, telophase I or interkinesis). Briefly explain what happens in each stage. [*Note: one stage is represented twice. You may include* ***one*** *description.*]



**C**

**A**



**B**



**D**

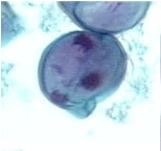
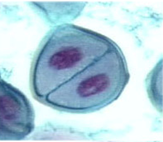
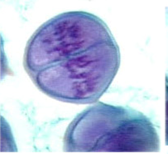
**E**

**F**

|  |  |  |
| --- | --- | --- |
| Diagram | Phase of Mitosis I | What happens? |
| A |  |  |
| B |  |  |
| C |  |  |
| D |  |  |
| E |  |  |
| F |  |  |

In Meiosis II, all the cells in a microsporangium are *not* in the same stage of division. Therefore, images of single cells have been taken for identification of these stages (*see next page)*.

1. Identify the stages of Meiosis II the cells are in (prophase II, metaphase II, anaphase II or telophase II). Briefly explain what happens in each stage. [*Note: some stages are represented more than once. You may include* ***one*** *description.*]

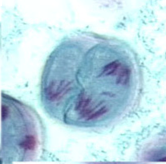


**B**

**C**



**A**

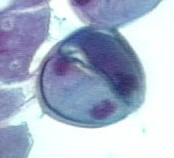


**E**

**D**

**F**

**F**



**I**

**H**

**G**

|  |  |  |
| --- | --- | --- |
| Diagram | Phase of Mitosis II | What happens? |
| A |  |  |
| B |  |  |
| C |  |  |
| D |  |  |
| E |  |  |
| F |  |  |
| G |  |  |
| H |  |  |
| I |  |  |

Analysis Questions

1. Compare the processes of meiosis I and meiosis II. How are they different and how are they similar? (Make at least 4 comparisons).
2. Why is meiosis important for sexual reproduction?
3. List three major differences between the events of mitosis and meiosis.
4. Compare mitosis and meiosis, by filling in the table below.

|  |  |  |
| --- | --- | --- |
|  | **Mitosis** | **Meiosis** |
| Chromosome number of parent cells (in humans) |  |  |
| Number of DNA replications |  |  |
| Number of divisions |  |  |
| Number of daughter cells produced |  |  |
| Chromosome number of daughter cells |  |  |
| Purpose/function |  |  |